

Intermediate-Level Blends of Ethanol in Gasoline, and the Ethanol “Blend Wall”

Updated July 1, 2011

Congressional Research Service

<https://crsreports.congress.gov>

R40445

Summary

On March 6, 2009, Growth Energy (on behalf of 52 U.S. ethanol producers) applied to the Environmental Protection Agency (EPA) for a waiver from the Clean Air Act (CAA) limitation on ethanol content in gasoline. Ethanol content in gasoline for all uses had been capped at 10% (E10); the application requested an increase in the maximum concentration to 15% (E15). A broad waiver would allow the use of more ethanol in gasoline than is currently permitted.

On October 13, 2010, EPA issued a partial waiver for the use of E15 in model year (MY) 2007 and later passenger cars and light trucks. At the same time EPA denied the waiver request for the use of E15 in MY2000 and older vehicles, and in motorcycles, heavy trucks, and non-road applications, citing a lack of sufficient data to alleviate concerns about potential emissions increases from these engines. EPA deferred a decision on MY2001-MY2006 cars and light trucks until January 2011, when the agency expanded the waiver for those vehicles after analyzing final testing data from the Department of Energy (DOE). Concerned about potential damage by E15 to equipment not designed for its use, a group of vehicle and engine manufacturers has challenged the partial waiver in court.

Of key concern before the waiver decision was made is the fact that a 10% limitation on ethanol content leads to an upper bound of roughly 15 billion gallons of ethanol in all U.S. gasoline. This "blend wall" will likely limit the fuel industry's ability to meet an Energy Independence and Security Act (EISA, P.L. 110-140) requirement to use increasing amounts of renewable fuels (including ethanol) in transportation. To meet the high volumes mandated by EISA, EPA recognized in a November 2009 letter to Growth Energy that "it is clear that ethanol will need to be blended into gasoline at levels greater than the current limit of 10 percent." The partial waiver for MY2001 and later vehicles—roughly two-thirds of the cars and light trucks on the road in 2011—will allow the use of more ethanol going forward, assuming other conditions are met.

To receive a waiver, the petitioner must establish to EPA that the increased ethanol content will not "cause or contribute to a failure of any emission control device or system" to meet emissions standards. In addition to the emissions concerns, other factors affecting consideration of the blend wall include vehicle and engine warranties and the effects on infrastructure. Currently, no automaker warrants its vehicles to use gasoline with higher than 10% ethanol. Small engine manufacturers similarly limit the allowable level of ethanol. In addition, most gasoline distribution systems (e.g., retail pumps and tanks) are designed to dispense up to E10. While some of these systems may be able to operate effectively on E15 or higher, their warranties/certifications would likely need to be modified. Further, many current state laws prohibit the use of blends higher than E10. Questions have been raised whether fuel suppliers would be willing to sell E15 alongside or in lieu of E10.

As EPA's waiver only applies to newer vehicles, a key question is how fuel pumps might be labeled to keep owners from using E15 in older vehicles and other equipment. Along with the waiver decision, EPA proposed new rules, including pump labeling, to prevent misfueling of E15 in vehicles not approved for its use. EPA finalized those rules in June 2011. EPA also sought comment (through December 17, 2010) on how to update guidance for underground storage tank (UST) owners, who must demonstrate compatibility of UST components with E15 before they may sell the fuel. Further, for EPA to allow the sale of E15, a fuel supplier would still need to register E15 with EPA and submit health effects testing for EPA to review—a process that had not been started as of late June 2011.

Contents

Background	1
What Is the “Blend Wall”?	5
Approval of New Fuels and Fuel Additives	6
What Studies or Data Must Accompany a Section 211(f) Waiver Request?	7
What Actions Are Federal Agencies Such as the Department of Energy and EPA Taking to Study the Compatibility of Higher Blends of Fuel in Non-flex Fuel Vehicles? What Are the Timelines of These Studies, and Will They Be Comprehensive Enough to Support a Section 211(f) Waiver Request?	8
What Are the Potential Outcomes of a Waiver Request?	9
What Entity Can Make a Request?	10
Other Than a Successful Section 211 Waiver Request, Are There Other Means to Approve Higher Blends of Ethanol, Such as an Executive Order or Other Administrative Action?	10
Growth Energy’s Waiver Application	11
Other Issues	12

Figures

Figure 1. Renewable Fuel Standard Under the Energy Independence and Security Act.....	2
Figure 2. Projected Ethanol Consumption in Gasoline at Selected Blend Levels vs. Renewable Fuel Standard Mandates	3
Figure 3. EPA’s New Label for E15 Dispensers	13

Contacts

Author Information.....	14
-------------------------	----

Background

There is continuing interest in the potential for ethanol to displace petroleum as a transportation fuel.¹ In 2010, the United States consumed roughly 13 billion gallons of fuel ethanol, representing about 10% of all U.S. gasoline consumption (by volume).² Fuel ethanol consumption has grown from roughly 1 billion gallons per year in the early 1990s, largely as a result of federal policies promoting its use, including tax incentives and mandates for the use of renewable fuels.³

Arguably the most significant incentive for ethanol's use is the renewable fuel standard (RFS) established in the Energy Policy Act of 2005⁴ and expanded in the Energy Independence and Security Act of 2007.⁵ The RFS mandates the use of 9.0 billion gallons of renewable fuel in 2008, increasing steadily through 2022 (**Figure 1**). While the RFS is not an explicit ethanol mandate, the vast majority of the requirement has been met using corn-based ethanol. Going forward, there are limitations on the amount of corn-based ethanol that may be used to meet the mandate, although it is likely that much of the additional mandate for "advanced biofuels"⁶ will be met using ethanol derived from sugarcane and from cellulosic feedstocks such as perennial grasses, fast-growing trees, and agricultural wastes.⁷ By 2022, EISA requires the use of 36 billion gallons of renewable fuels, and much of this would likely be ethanol from a variety of feedstocks.

¹ For more information on fuel ethanol, see CRS Report RL33290, *Fuel Ethanol: Background and Public Policy Issues*, by Brent D. Yacobucci.

² Renewable Fuels Association (RFA), Industry Statistics, <http://www.ethanolrfa.org/industry/statistics/>, accessed June 27, 2011.

³ CRS Report R40110, *Biofuels Incentives: A Summary of Federal Programs*, by Brent D. Yacobucci.

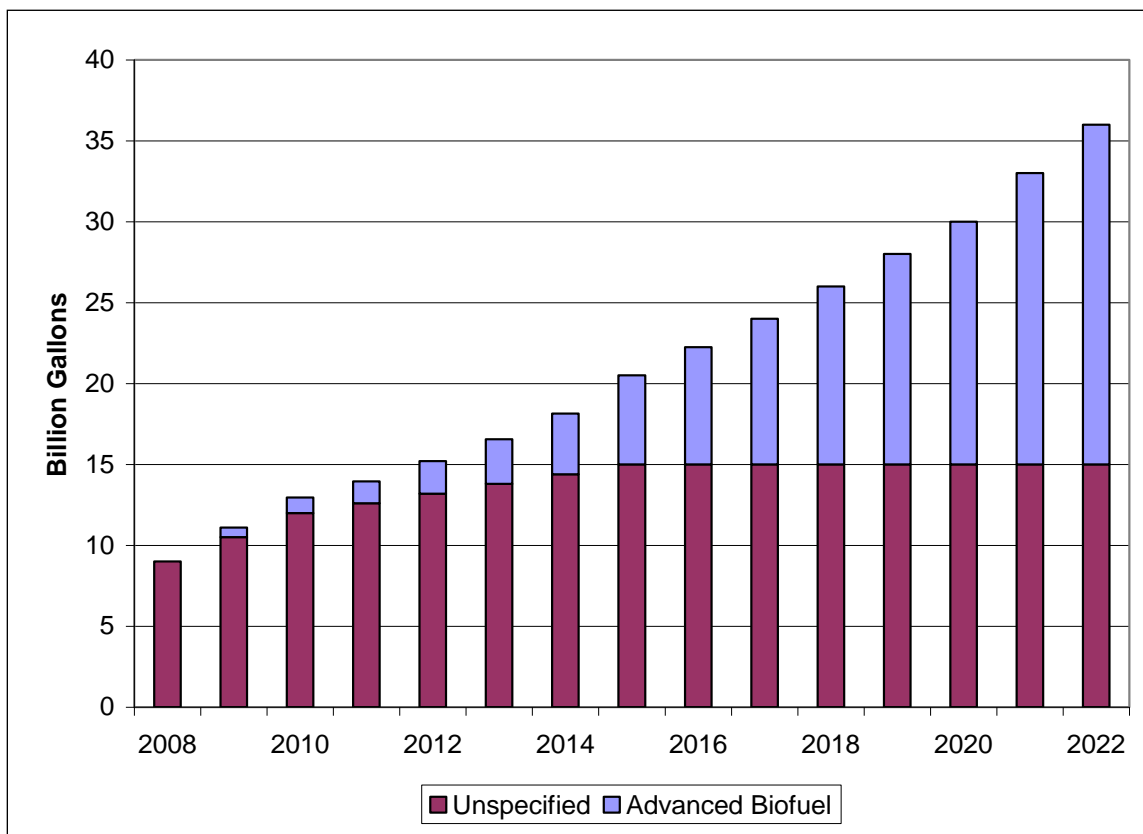
⁴ EPA Act 2005, P.L. 109-58.

⁵ EISA, P.L. 110-140.

⁶ Biofuels produced from feedstocks other than corn starch and with 50% lower lifecycle greenhouse gas emissions compared to gasoline.

⁷ For more information on the RFS, see CRS Report R40155, *Renewable Fuel Standard (RFS): Overview and Issues*, by Randy Schnepf and Brent D. Yacobucci.

Figure I. Renewable Fuel Standard Under the Energy Independence and Security Act



Source: CRS Analysis of P.L. 110-140.

However, there is a key obstacle to the use of so much ethanol in gasoline. Currently, although some ethanol is sold as an alternative fuel (E85),⁸ most is sold as an additive in conventional and reformulated gasoline. Before EPA's decision on the Growth Energy waiver petition, the amount of ethanol that could be blended in gasoline for all conventional gasoline vehicles and engines was limited to 10% by volume (E10) by guidance developed by the Environmental Protection Agency (EPA) under the Clean Air Act (CAA), as well as by vehicle and engine warranties, and certification procedures for fuel-dispensing equipment.

Under the RFS, assuming that most of the mandate is met using ethanol, gasoline blenders are likely to hit a limit in the next few years. In 2012, the RFS will require over 15 billion gallons of renewable fuel, while projected gasoline consumption in 2012 is just above 140 billion gallons.⁹ After 2012, the renewable fuel mandate will continue to increase. However, a limit of 10% ethanol would mean that ethanol for gasoline blending (not including E85) likely cannot exceed 14 billion gallons per year.¹⁰ This "blend wall" is the maximum possible volume of ethanol that

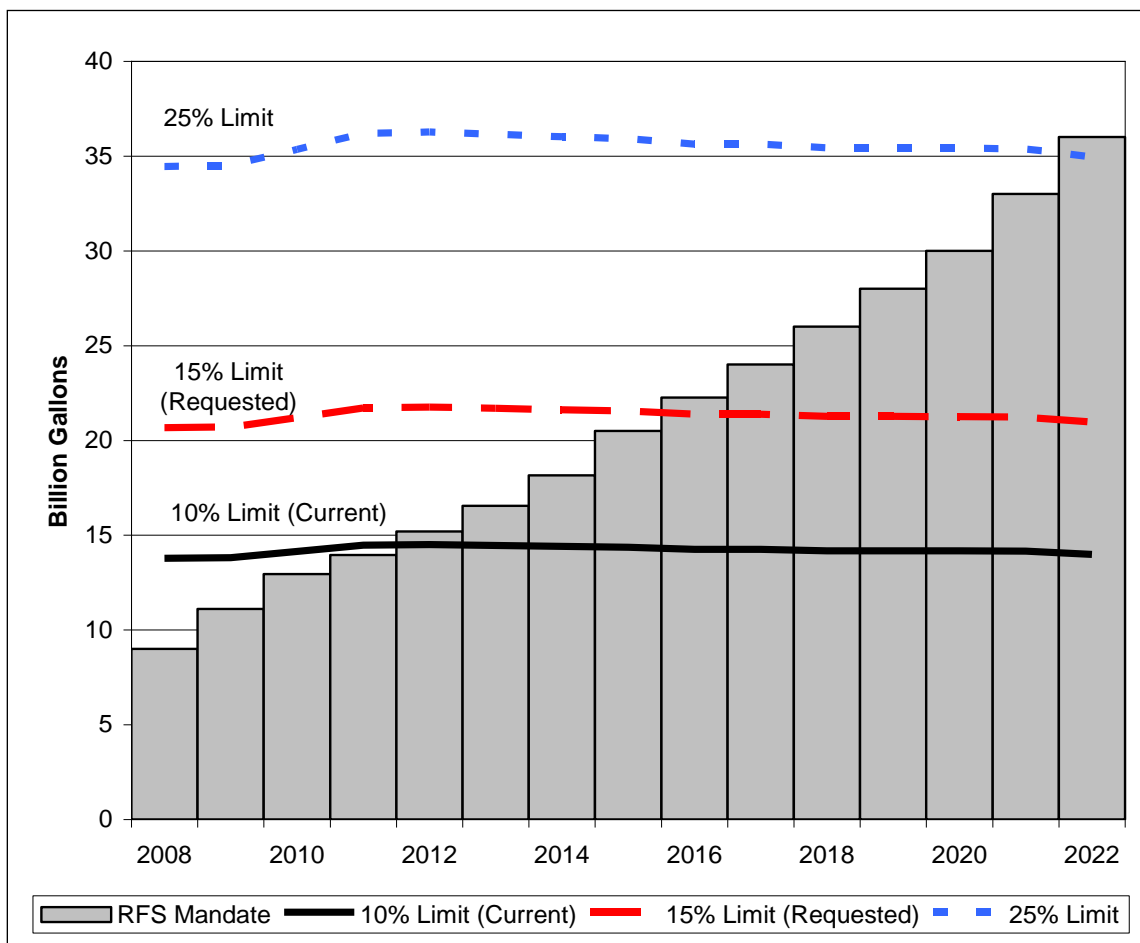
⁸ A blend of 85% ethanol and 15% gasoline. Ethanol-gasoline blends are designated with an "E" followed by a number—the percentage ethanol concentration by volume. For example, a blend of 10% ethanol and 90% gasoline is referred to as "E10."

⁹ U.S. Energy Information Administration (EIA), *Annual Energy Outlook 2011*, April 26, 2011, Reference Case Table 11.

¹⁰ If gasoline demand were to increase, the maximum amount of ethanol that could be blended into that gasoline would

can be blended into U.S. motor gasoline (see **Figure 2**). It is likely that the actual limit is lower, since older fuel tanks and pumps at some retail stations may not be equipped to handle ethanol-blended fuel.

Figure 2. Projected Ethanol Consumption in Gasoline at Selected Blend Levels vs. Renewable Fuel Standard Mandates



Source: RFS mandates from P.L. 110-140. Projected ethanol consumption at various limits from CRS analysis of U.S. Energy Information Administration, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010), Washington, DC, May 11, 2010, Reference Case Table 11, http://www.eia.doe.gov/oiaf/aeo/aeoref_tab.html.

Notes: Although the RFS is not an explicit ethanol mandate, it has been widely interpreted as an effective mandate given the current market and technology conditions. However, other biofuels are expected to play a somewhat limited role, at least in the near future. For example, a share of the RFS mandate must be met using biomass-based diesel fuels. That share is 0.65 billion gallons in 2009, rising to 1.0 billion gallons in 2012. After 2012, EPA is to set the mandated level.

increase proportionally. Likewise, if gasoline demand were to decrease, the maximum amount of ethanol that could be blended would decrease proportionally.

Because of this “blend wall,” there is interest, especially among ethanol producers, in increasing the allowable concentration of ethanol in gasoline. Research is ongoing on intermediate-level blends, including 15%, 20%, 30%, and 40% ethanol (E15, E20, E30, and E40, respectively).

On March 6, 2009, Growth Energy (on behalf of 52 U.S. ethanol producers) applied to EPA for a waiver from the CAA E10 limit.¹¹ The application requested an increase in the maximum concentration to 15% (E15). The waiver would allow the use of significantly more ethanol in gasoline than was permitted under the 10% limit.¹² Under EISA, EPA had 270 days (December 1, 2009) to grant or deny the waiver. In a November 2009 letter to Growth Energy, EPA noted that “it is clear that ethanol will need to be blended into gasoline at levels greater than the current limit of 10 percent”¹³ to meet the EISA mandates. In the letter, EPA noted that long-term testing on newer vehicles had not been completed, but that the agency expected that model year 2001 and newer vehicles “will likely be able to accommodate higher ethanol blends, such as E15.”¹⁴ On October 13, EPA granted a partial waiver for MY2007 and later vehicles, and deferred a decision on MY2001-MY2006 vehicles until it received final testing data from the Department of Energy (DOE)¹⁵—EPA granted that waiver on January 26, 2011. As part of the October 2010 decision,¹⁶ EPA denied the waiver for use of E15 in MY2000 and older passenger vehicles, as well as for all heavy-duty vehicles, motorcycles, marine engines, and non-road equipment. However, a group of engine and equipment manufacturers has challenged the partial waiver in court, arguing that EPA failed to estimate the likelihood of misfueling (using E15 equipment denied a waiver), and the economic and environmental consequences of that misfueling.¹⁷

EPA estimates that MY2007 and later vehicles will represent 29% of the cars and light trucks on the road in 2011. Expanding the waiver to MY2001 and later covers an additional 38% of vehicles.¹⁸ As newer vehicles are driven longer distances than older vehicles, MY2001 and later vehicles would represent an even larger share of vehicle miles traveled and fuel consumption.

As part of the decision, EPA stated that it had “reasons for concern with use of E15 in nonroad products, particularly with respect to long-term exhaust and evaporative emissions durability and materials compatibility.”¹⁹ EPA denied this part of the waiver petition but stated that the agency

¹¹ Growth Energy on Behalf of 52 United States Ethanol Manufacturers, *Application for a Waiver Pursuant to Section 211(f)(4) of the Clean Air Act for E-15*, March 6, 2009.

¹² Instead of the roughly 14-billion-gallon limit in 2012 discussed above, ethanol could represent up to roughly 22 billion gallons of gasoline content.

¹³ Gina McCarthy, *Notice of a Receipt of a Clean Air Act Waiver Application to Increase the Allowable Ethanol Content of Gasoline to 15 Percent; Letter to Petitioners*, U.S. Environmental Protection Agency, Office of Air and Radiation, Washington, DC, November 30, 2009, p. 1, <http://www.epa.gov/otaq/regs/fuels/additive/lettertogrowthenergy11-30-09.pdf>.

¹⁴ *Ibid.*, p. 2.

¹⁵ U.S. Environmental Protection Agency (EPA), *Partial Grant and Partial Denial of Clean Air Act Waiver Application Submitted by Growth Energy to Increase the Allowable Ethanol Content of Gasoline to 15 Percent; Decision of the Administrator*, Washington, DC, October 13, 2010, <http://www.epa.gov/otaq/regs/fuels/additive/e15/e15-waiver-decision.pdf>.

¹⁶ EPA, *Partial Grant of Clean Air Act Waiver Application Submitted by Growth Energy to Increase the Allowable Ethanol Content of Gasoline to 15 Percent; Decision of the Administrator*, Washington, DC, January 26, 2011, <http://www.regulations.gov/contentStreamer?objectId=0900006480bd33d3&disposition=attachment&contentType=pdf>

¹⁷ Outdoor Power Equipment Institute (OPEI), *Fact Sheet: E-15 Partial Waiver Legal Challenge*, December 17, 2010. The case is *Alliance of Automobile Manufacturers et. al v. Environmental Protection Agency*.

¹⁸ EPA, October 13, 2010. *Op. cit.*

¹⁹ *Ibid.*

would revisit the issue if new data were submitted. In a July 2010 “Status Update” EPA stated that

Although we continue to evaluate all available information, it has become clear that insufficient data have been submitted on the use of E-15 in older vehicles and non-road engines (such as chainsaws and marine engines) to enable EPA to make a decision on a waiver that would allow the use of E-15 for these engines.²⁰

As noted by EPA, granting Growth Energy’s petition to increase gasoline ethanol content to 15% addresses only one component of the blend wall. The other impediments—current state laws, vehicle and engine warranties, and distribution infrastructure—still need to be addressed before ethanol use in gasoline is taken beyond 10%. Further, for EPA to allow the sale of E15, a fuel supplier still needs to register the fuel with EPA and submit health effects testing for EPA to review—a process that has not yet been started.

What Is the “Blend Wall”?

The “blend wall” is the upper limit to the total amount of ethanol that can be blended into U.S. gasoline. Before 2010 gasoline ethanol content for all uses was limited to 10% by volume, and in 2009 gasoline consumption was roughly 140 billion gallons.²¹ Therefore, the 10% blend wall is roughly 14 billion to 15 billion gallons of ethanol that could be blended into gasoline.²² The blend wall is largely driven by four factors.

First, under the CAA it is unlawful to sell gasoline that contains additives at levels higher than those approved by EPA. For ethanol, the limit was 10% by volume for all vehicles through 2010. To allow a higher percentage, a fuel manufacturer would need to petition EPA for a waiver. (See “Approval of New Fuels and Fuel Additives.”)

Second, automakers currently warranty their vehicles to operate on ethanol/gasoline blends up to 10%. While there are data to suggest that newer vehicles could be operated reliably on higher levels of ethanol without modification, no automaker has yet approved those higher blends for use.²³ Further, small engine manufacturers generally advise against using gasoline with more than 10% ethanol in machines such as lawnmowers, trimmers, and snowmobiles. Even with EPA’s approval of higher ethanol blends for use in some vehicles, it is unclear whether vehicle and machine owners will be willing to use the new fuel without explicit approval from the engine/vehicle manufacturer.²⁴

²⁰ Ibid.

²¹ Beyond the blend wall, more ethanol could be used in transportation, as E85 in flexible fuel vehicles (FFVs) specially designed for its use. However, there are far fewer FFVs than conventional vehicles, and most of these are currently operated on gasoline. If all of the roughly 8 million FFVs were operated on E85 all of the time, that could represent an additional 5 billion to 6 billion gallons of ethanol use beyond the limits of the blend wall.

²² Technically, the theoretical blend wall is a number slightly higher than 10% of gasoline consumption. Ethanol has a lower energy content than gasoline, thus one gallon of ethanol does not displace an entire gallon of gasoline. As the share of ethanol in gasoline increases, the total volume must increase to provide an equivalent amount of energy. For example, 140 billion gallons of gasoline would have the equivalent energy to roughly 145 billion gallons of a 10% ethanol blend.

²³ For example, in Brazil all gasoline contains between 20% and 25% ethanol. While specific vehicle requirements differ between the United States and Brazil, especially emissions control standards, there is reason to believe that somewhat higher blends could be used in the United States.

²⁴ This was a key concern in the state of Minnesota. That state mandates that all gasoline in the state contain 10% ethanol. That mandate is set to increase to 20% in 2013, but only if EPA approves the use of the fuel, and automakers

Third, most existing infrastructure (e.g., underground gasoline storage tanks, fuel pumps) is designed and certified to deliver blends up to E10. It is unclear whether it can tolerate higher ethanol concentrations. Underwriters Laboratories (UL), an independent testing and certification company, announced guidance supporting the use of ethanol blends up to a maximum of 15% in existing fuel pumps currently certified to dispense E10.²⁵ However, according to the same announcement, UL stated that “under normal business conditions, E10 at the dispenser can vary from about seven to 13 percent ethanol.”²⁶ However, a similar variance is likely to exist for E15: according to a UL representative, “it cannot ever be said that [E15] is exactly 15 percent.”²⁷ Therefore, a higher maximum level, perhaps 18%, would be necessary to allow those pumps to be certified to deliver E15. In November 2010, the National Renewable Energy Laboratory (NREL) released a study (conducted by UL) on the compatibility of new and legacy equipment (listed to dispense up to E10) with E15.²⁸ UL determined that some of the testing was inconclusive, and some parts did corrode. While modifications to address some of these corrosion issues might be relatively inexpensive, some may represent a significant cost to fuel retailers.

In March 2010, UL certified two new pumps to dispense blends up to E25.²⁹ Further, one pump manufacturer, Gilbarco, retroactively expanded its warranty coverage to E15 for pumps manufactured after April 1, 2008.³⁰

Fourth, many state laws and regulations, including fire codes and other standards, limit ethanol in gasoline to 10%. To allow E15, these state laws and regulations would also need to be amended. In addition, private or state insurance restrictions may or may not reflect changes to UL certification.

While all of these components of the blend wall are relevant, this report focuses on the process for addressing the first component, the CAA restriction on ethanol concentration in gasoline.

Approval of New Fuels and Fuel Additives

For a blend of gasoline and gasoline additives to be approved under Section 211(f)(1)(A) of the CAA, it must be “substantially similar” to unleaded gasoline.³¹ EPA has defined “gasoline” to have an upper limit of 2.7% oxygen content (by weight), effectively limiting the ethanol concentration to roughly 7.5% (by volume).³² However, Section 211(f)(4) of the CAA (as amended by EISA) allows manufacturers of fuels and fuel additives to apply for a waiver from

warranty their vehicles to operate on the fuel.

²⁵ Underwriter’s Laboratories, *Underwriter’s Laboratories Announces Support for Authorities Having Jurisdiction Who Decide to Permit the Use of Existing UL Listed Gasoline Dispensers with Automotive Fuel Containing up to a Maximum of 15% Ethanol*, Northbrook, IL, February 19, 2009.

²⁶ Ibid.

²⁷ Christopher Jensen, “Laboratory Will Not Certify Pumps for Gas with 15 Percent Ethanol,” *New York Times*, May 8, 2009.

²⁸ Kenneth Boyce and Thomas Chapin, *Dispensing Equipment Testing With Mid-Level Ethanol/Gasoline Test Fluid*, National Renewable Energy Laboratory, Subcontract Report NREL/SC-7A20-49187, Golden, CO, November 2010, <http://www.nrel.gov/docs/fy11osti/49187.pdf>.

²⁹ U.S. Department of Energy, *Technology Bulletin: Underwriters Laboratories Ethanol Dispenser Safety Testing*, August 12, 2010, http://www.afdc.energy.gov/afdc/technology_bulletin_0307.html.

³⁰ Ibid. It should be noted that UL has not certified these pumps to dispense E15.

³¹ 42 U.S.C. 7545(f)(1)(A).

³² EPA, “Regulation of Fuels and Fuel Additives; Definition of Substantially Similar,” Revised Interpretive Rule, Final Action, February 11, 1991. 56 *Federal Register* 5332-5336.

the “substantially similar” requirement if they can prove that the use of the fuel or additive will not “cause or contribute to” a vehicle not meeting applicable emissions standards over its useful life.

The EPA Administrator, upon application of any manufacturer of any fuel or fuel additive, may waive the prohibitions established under paragraph (1) or (3) of this subsection or the limitation specified in paragraph (2) of this subsection, if he determines that the applicant has established that such fuel or fuel additive or a specified concentration thereof, and the emission products of such fuel or fuel additive or specified concentration thereof, will not cause or contribute to a failure of any emission control device or system (over the useful life of the motor vehicle, motor vehicle engine, nonroad engine or nonroad vehicle in which such device or system is used) to achieve compliance by the vehicle or engine with the emission standards with respect to which it has been certified pursuant to Sections 206 and 213(a) of this title. The Administrator shall take final action to grant or deny an application submitted under this paragraph, after public notice and comment, within 270 days of the receipt of such an application.³³

EPA has twice granted waivers for 10% ethanol under Section 211(f). The first was granted in 1978 to Gas Plus, Inc. for blends of ethanol up to 10%.³⁴ The second was in 1982 to Synco 76 Fuel Corp. for a blend of 10% ethanol plus a proprietary additive.³⁵ To allow the use of E15 or E20, EPA would need to revise its definition of “substantially similar” to allow a higher oxygen content, or a manufacturer would need to petition EPA for a waiver under Section 211(f), as Growth Energy has done.

What Studies or Data Must Accompany a Section 211(f) Waiver Request?

According to EPA, there are no specific guidelines for what data must accompany a waiver application. However, based on communication between EPA’s Office of Transportation and Air Quality (OTAQ) and the Minnesota Department of Agriculture,³⁶ as well as a presentation made by a member of OTAQ staff to the American Petroleum Institute Technology Committee,³⁷ a submission must

- include both evaporative and exhaust emissions;
- be comprehensive, assessing the emissions effects both short-term and over the full useful life of the vehicle;³⁸
- include tests on a variety of vehicles (e.g., new and used, car, truck, and motorcycle), and the selection of vehicles should reflect their frequency on the road; and

³³ 42 U.S.C. 7545(f).

³⁴ 44 *Federal Register* 20777.

³⁵ 47 *Federal Register* 22404.

³⁶ Margo Oge, U.S. Environmental Protection Agency, Office of Transportation and Air Quality (OTAQ), Letter to Gene Hugoson, Director, Minnesota Department of Agriculture, March 6, 2008.

³⁷ Karl Simon, EPA, OTAQ, “Mid Level Ethanol Blend Experimental Framework—EPA Staff Recommendations,” Presentation to the American Petroleum Institute Technology Committee Meeting, Chicago, June 4, 2008.

³⁸ Full useful life for modern cars and light trucks is 150,000 miles. For motorcycles, full useful life is 20,000 miles. EPA expects that the aging of the vehicles will occur under both controlled (e.g., dynamometer) and on-road environmental (e.g., hot and cold weather) conditions.

- assess the durability of vehicles and vehicle parts using the fuel, including assessments of the compatibility of the new fuel (or blend level) with engine materials, and the effects on operability and performance.

Because gasoline is also used in other engines (e.g., lawnmowers, snowmobiles, boats, etc.), the long-term effects on emissions and engine durability for these engines must also be studied, according to EPA. In the case of higher-level ethanol blends, this may be a key concern. While newer automobiles have complex fuel systems, including computers that can measure and adjust fuel/air ratios in real time, most small non-road engines have much simpler carburetor systems with set fuel/air ratios. One potential problem is that ethanol contains oxygen:³⁹ by increasing the oxygen content in the fuel—increasing the ethanol content from 10% to 20% effectively doubles the oxygen content—while keeping the amount of air coming into the engine constant, the engine will run much leaner. This could cause the engine to misfire, and/or to run much hotter than originally designed, especially in the case of air-cooled engines (e.g., lawnmowers).

After the waiver is granted, but before sale of the new fuel is permitted, the fuel must be registered with EPA. That registration must include an assessment of the health effects of the fuel (e.g., inhalation exposure studies).

What Actions Are Federal Agencies Such as the Department of Energy and EPA Taking to Study the Compatibility of Higher Blends of Fuel in Non-flex Fuel Vehicles? What Are the Timelines of These Studies, and Will They Be Comprehensive Enough to Support a Section 211(f) Waiver Request?

Research has been completed or is ongoing on many of the above data requirements. Much of the preliminary research has been conducted by or for the state of Minnesota. Minnesota has a state law requiring the use of E10 across the state. Assuming E20 is approved as a motor fuel, the state will mandate its use starting in 2013. Therefore, Minnesota has headed much of the research that led to the Growth Energy waiver application. According to the Minnesota Department of Agriculture, some of the preliminary research has been completed or is ongoing on materials compatibility and driveability.⁴⁰

In a presentation to EPA's Clean Air Act Advisory Committee's Mobile Sources Technical Review Committee, representatives of Chrysler and Honda highlighted key research areas in assessing mid-level ethanol blends.⁴¹ For cars and trucks they categorized the research into seven main topics: durability, tailpipe emissions, evaporative emissions, driveability, materials compatibility, emissions inventory, and on-board diagnostic (OBD) integrity. For most of these topics, they showed that fuel producers, automakers, EPA and/or DOE had completed "preliminary, partial or screening" assessments, but that comprehensive testing had just started in

³⁹ In modern vehicles, additional oxygen is generally a benefit in that it promotes more complete combustion, potentially reducing carbon monoxide and other pollutant emissions.

⁴⁰ Ralph Groschen, Minnesota Department of Agriculture, "What's Happening With E20?," Presentation to the Iowa Renewable Fuels Summit, Des Moines, IA, January 31, 2008. In her letter to Gene Hugoson of the Minnesota Department of Agriculture, OTAQ Director Oge stated that "the draft reports presented to us ... are a good first step in beginning the evaluation of the effects of E20. We understand that you consider these test results to be preliminary and not sufficient for a complete waiver application, and we agree with that determination." Margo Oge, op. cit.

⁴¹ Reg Modlin, Chrysler Corporation, and Dave Rainey, Honda Motor Company, "Assessing Effects of Mid-Level Ethanol Blends," Presentation to the Mobile Sources Technical Review Subcommittee Meeting, Arlington, VA, May 8, 2008.

some areas, while other areas may still need to be addressed. According to their timeline, much of the comprehensive research would not have been completed before the end of 2009. Similar research must be completed for non-road engines. However, their timeline showed that the planning for that research was incomplete as of mid-2008.

In its November 30, 2009, letter to Growth Energy, EPA noted that durability testing was ongoing at DOE. According to the letter, DOE was testing a total of 19 newer vehicles, had completed testing of two of those vehicles, and expected "testing [to] be completed on an additional 12 vehicles by the end of May 2010. As a result EPA expects to have a significant amount of the total data being generated through this testing program available to us by mid-June."⁴² The letter made no comment on the status of testing for older vehicles or for non-road engines.

In its July 2010 update, EPA pushed back the expected completion date for testing of the newest (model year 2007 and later) vehicles to the end of September. The completion of that testing led to EPA's granting a partial waiver in October 2010. For vehicles between model years 2001 and 2006, EPA expected DOE to complete testing by late November 2010. EPA received that data and expanded the waiver in January 2011. For older vehicles and non-road engines, EPA stated that insufficient data have been submitted to alleviate concerns about durability and evaporative emissions—thus EPA denied that part of the waiver. However, as noted above, the partial waiver has been challenged in court by automakers and other equipment manufacturers concerned about the effects of misfueling.

What Are the Potential Outcomes of a Waiver Request?

Under CAA Section 211(f)(4), as amended by Section 251 of EISA, the Administrator must grant or deny the waiver request within 270 days of receipt. Before being amended by EISA, the language in Section 211(f)(4) stated that "if the Administrator has not acted to grant or deny an application under this paragraph within one hundred and eighty days of receipt of such application, the waiver authorized by this paragraph shall be treated as granted." The amended section no longer specifies the status of a waiver request if EPA neither grants nor denies the request within 270 days, as was the case with Growth Energy's request.

A question that has been raised is whether EPA can grant a partial waiver. For example, some contended that it is possible for EPA to quickly grant a waiver to allow E12 or E13, and take more time to review Growth Energy's application for E15. In press reports, Agriculture Secretary Tom Vilsack supported this strategy.⁴³ In a June 2010 letter, Archer Daniels Midland Company (ADM) requested that EPA grant a waiver for E12 or determine that E12 is "substantially similar" to E10. In its decision on the Growth Energy petition, EPA determined that there were insufficient data to determine that E12 was substantially similar, that similar data concerns exist for older vehicles and non-road engines, and that for newer vehicles E12 is subsumed in the waiver for E15.⁴⁴

⁴² Gina McCarthy, *Notice of a Receipt of a Clean Air Act Waiver Application to Increase the Allowable Ethanol Content of Gasoline to 15 Percent; Letter to Petitioners*, U.S. Environmental Protection Agency, Office of Air and Radiation, Washington, DC, November 30, 2009, pp. 1-2, <http://www.epa.gov/otaq/regs/fuels/additive/lettertogrowthenergy11-30-09.pdf>.

⁴³ Christopher Doering, "USDA Chief Backs Boost of Ethanol Blend in Gasoline," *Reuters*, March 9, 2009.

⁴⁴ U.S. Environmental Protection Agency, *Partial Grant and Partial Denial of Clean Air Act Waiver Application Submitted by Growth Energy to Increase the Allowable Ethanol Content of Gasoline to 15 Percent; Decision of the Administrator*, Washington, DC, October 13, 2010, <http://www.epa.gov/otaq/regs/fuels/additive/e15/e15-waiver-decision.pdf>.

What Entity Can Make a Request?

According to CAA Section 211(f)(4), the EPA Administrator may waive the limitations “upon application of any manufacturer of any fuel or fuel additive.” Therefore, presumably any gasoline or ethanol producer may petition EPA for the waiver, provided they can demonstrate to EPA that the new additive or (in this case) specified concentration of an existing additive will meet the criteria set out in Section 211(f)(4).⁴⁵ In the case of the current waiver application, Growth Energy filed the application on behalf of 52 U.S. ethanol manufacturers,⁴⁶ in partnership with the American Coalition for Ethanol, the Renewable Fuels Association, and the National Ethanol Vehicle Coalition.

Other Than a Successful Section 211 Waiver Request, Are There Other Means to Approve Higher Blends of Ethanol, Such as an Executive Order or Other Administrative Action?

The provisions of Section 211 are explicit, and there seem to be few options outside of the Section 211(f)(4) waiver process for E15 or other intermediate blends to be approved. While there may be no administrative action that could permit the use of E15 other than an EPA waiver or a determination that E15 is “substantially similar” to gasoline, there are potential legislative options. These include

- amending the CAA to explicitly allow the use of E15 (or some other level of ethanol);
- amending the CAA to provide expedited approval of higher levels of previously approved fuel additives; and
- mandating the production and sale of flexible fuel vehicles (since intermediate blends between E85 and E0—straight gasoline with no ethanol—are already approved for use in these vehicles), and promoting (or mandating) the use of E85 fuel.

⁴⁵ There has been some confusion over whether the petition would have to come from a gasoline producer (since the waiver is for increased ethanol content in gasoline), but the language in Section 211(f)(4) states that the application may come from “any manufacturer of any fuel or fuel additive.”

⁴⁶ While the cover page of the application mentions 52 for the number of ethanol manufacturers represented, the text of the application lists 54 companies: Absolute Energy, LLC; Agri-Energy LLC/Dakota Renewable; Amazing Energy, LLC; Arizona Grain Inc.; Arkalon Energy, LLC; Big River Resources, LLC; Cardinal Ethanol, LLC; Castle Rock Renewable Fuels, LLC; Conestoga Energy; DENCO; Didion Ethanol, East Kansas Agri Energy, LLC; Front Range Energy LLC; Golden Grain Energy, LLC; Granite Falls Energy, LLC; Green Plains Renewable Energy, Inc.; Hawkeye Renewables LLC, IBEC Ethanol; ICM; Kansas Ethanol, LLC; LifeLine Foods, Inc.; Little Sioux Corn Processors, LLC; Marquis Energy, LLC; Nesika Energy, LLC; Patriot Renewable Fuels, LLC; Pinal Energy, Poet Biorefining—Alexandria; Poet Biorefining—Ashton; Poet Biorefining—Big Stone; Poet Biorefining—Caro; Poet Biorefining—Chancellor; Poet Biorefining—Coon Rapids; Poet Biorefining—Corning; Poet Biorefining—Emmetsburg; Poet Biorefining—Glenville; Poet Biorefining—Gowrie; Poet Biorefining—Groton; Poet Biorefining—Hanlontown; Poet Biorefining—Hudson; Poet Biorefining—Jewell; Poet Biorefining—Laddonia; Poet Biorefining—Lake Crystal; Poet Biorefining—Leipsic; Poet Biorefining—Macon; Poet Biorefining—Mitchell; Poet Biorefining—Portland; Poet Biorefining—Preston; POET Ethanol Products; Prairie Horizon Agri-Energy LLC; Quad County Corn Processors; Renew Energy; Siouxland Ethanol LLC; Sire; and Western Plains Energy, LLC.

Growth Energy's Waiver Application

As stated above, on March 6, 2009, Growth Energy petitioned EPA for a waiver to allow the use of up to 15% ethanol in gasoline. Under the CAA, EPA had up to 270 days (December 1, 2009) to approve or deny the waiver request, but on November 30, 2009, EPA sent a letter to Growth Energy stating that not enough testing had been completed, and that it would continue to evaluate the petition.⁴⁷ On October 13, 2010, EPA granted a partial waiver for MY2007 and later passenger vehicles; EPA denied the waiver for MY2000 and older vehicles, as well as for heavy-duty vehicles, motorcycles, and non-road equipment; and deferred a decision on MY2001-MY2006 passenger vehicles.

In its application, Growth Energy stated that "recent and extensive research demonstrates that use of higher ethanol blends will significantly benefit the environment by reducing greenhouse gas emissions, reducing harmful tailpipe emissions, reducing smog, using less energy for an equivalent amount of fuel, and protecting natural resources."⁴⁸ Growth Energy contended that

available data and multiple recent studies⁴⁹ regarding the impact of various intermediate blends [of ethanol] on emissions, materials compatibility, durability, and driveability, were completed on extensive and representative test fleets, provide a reliable comparison to certification conditions, and demonstrate that use of E-15 will not cause or contribute to failure of any emission control device or system to meet its certification emissions standards.⁵⁰

Growth Energy cited a DOE study⁵¹ that found a statistically significant decrease in carbon monoxide emissions using E15, and a marginally significant decrease in non-methane hydrocarbon emissions.⁵² The same study also found a statistically significant increase in acetaldehyde emissions, and a marginally significant increase in formaldehyde emissions.⁵³ Both formaldehyde and acetaldehyde are regulated as toxic air pollutants under Sections 202 and 211 of the CAA. However, the fact that emissions increased using the fuel is not enough for EPA to deny the waiver: EPA would need to prove that the increase in emissions is enough to cause the vehicle or engine to fall out of compliance with emissions standards. Growth Energy asserts that the DOE study and other studies have found that the use of E15 results in emissions within applicable limits.⁵⁴ In its November 30 letter to Growth Energy, EPA stated that "we want to make sure we have all necessary science to make the right decision," including more long-term testing data.⁵⁵

On October 13, 2010, EPA granted a partial waiver for newer (MY2007 and later) passenger cars and light trucks, initially deferring a decision on MY2001-MY2006 passenger vehicles before granting the partial waiver on January 26, 2011, and denied the waiver for older passenger

⁴⁷ Gina McCarthy, op. cit., p. 2.

⁴⁸ Growth Energy, op. cit., p. 2.

⁴⁹ Growth Energy cites seven studies completed by or for the U.S. Department of Energy, the American Coalition for Ethanol, the State of Minnesota, the Coordinating Research Council, the Rochester Institute of Technology, the Minnesota Center for Automotive Research, and Stockholm University.

⁵⁰ Ibid., p. 6.

⁵¹ U.S. Department of Energy, *Effects of Intermediate Ethanol Blends on Legacy Vehicles and Small Non-Road Engines*, Report 1, Oak Ridge, TN, October 2008.

⁵² Growth Energy, op. cit., p. 16.

⁵³ Ibid.

⁵⁴ Ibid., p. 18.

⁵⁵ Gina McCarthy, op. cit., p. 1.

vehicles as well as all other vehicles. In its October 13 decision, EPA determined that there were insufficient data to alleviate concerns over potential emissions increases from older passenger vehicles and non-road engines.

Other Issues

As stated above, the EPA waiver is not the only hurdle in enabling the use of intermediate-level ethanol blends. With the waiver granted, a fuel supplier still must register the fuel with EPA under the CAA, a process which includes an assessment of the health effects of the fuel.

A key non-vehicle issue is whether existing infrastructure can support ethanol blends above E10. Like automobiles, while some existing gasoline tanks and pumps were designed and/or certified to handle up to E10, none to date have been designed or certified to handle higher ethanol blends.⁵⁶ Even with approval by EPA for use in newer motor vehicles, presumably fuel suppliers and/or retailers would be unwilling to sell the fuel unless they are confident that it will not damage their existing systems or lead to liability issues in the future, and that they will not compromise their insurance coverage. Otherwise, it seems doubtful that fuel suppliers and retailers would voluntarily upgrade their systems to handle the new fuel.

For example, underground storage tank (UST) owners must demonstrate that the components of their UST systems are compatible with the fuel they are storing under the UST provisions of the Solid Waste Disposal Act. EPA took comments through December 17, 2010, on updating its guidance to include ways for owners to demonstrate compatibility with E15.⁵⁷ Further, loan covenants and insurance policies would need to be modified to reflect the use of the higher ethanol blend.

In addition to fuel supply concerns, for vehicle and machine owners to accept the new fuel, engine and auto manufacturers would likely need to convince their customers that both new and existing equipment would not be damaged by using the new fuel, and that its use would not void vehicle and equipment warranties. This may be especially difficult for small-engine manufacturers and users who are currently concerned about the effects on their engines from E10, let alone higher blends of ethanol. Because of concerns over potential misfueling, a group of automobile and equipment manufacturers⁵⁸ has challenged the partial waiver in court. They argue that EPA did not estimate the likelihood of misfueling or the potential economic and environmental effects.⁵⁹ They also argue that some misfueling may be unavoidable if E15 becomes so prevalent that fuel suppliers stop selling E10.

Many state laws and regulations limit the use of ethanol in gasoline to 10%. These state rules would also need to be updated to allow widespread use of E15. Further, gasoline retailers are

⁵⁶ Potential concerns that have been raised include whether the higher ethanol concentration will corrode seals and other components, and whether the higher concentration would lead to stress cracking of tanks and other metal components.

⁵⁷ U.S. Environmental Protection Agency, "Compatibility of Underground Storage Tank Systems With Biofuel Blends: Notice of proposed guidance and request for comments," 75 *Federal Register* 70241-70246, November 17, 2010.

⁵⁸ The Alliance of Automobile Manufacturers (Alliance), the Association of International Automobile Manufacturers, Inc. (AIAM), the National Marine Manufacturers Association (NMMA), and the Outdoor Power Equipment Institute (OPEI).

⁵⁹ OPEI, Op. cit.

concerned that they could lose insurance coverage if they distribute gasoline with higher than 10% ethanol concentration.⁶⁰

A key issue raised with EPA's partial waiver decision is the likelihood of misfueling of E15 in vehicles and engines not approved for its use. As part of the October 2010 partial waiver approval, EPA proposed new rules to prevent misfueling, including requiring new labels for fuel pumps that dispense E15. EPA finalized the misfueling rules in June 2011.⁶¹ Along with public comments, EPA consulted with the Federal Trade Commission (FTC) to harmonize the design and content of the label with current FTC labeling rules for motor fuels. One of the key questions was whether the label should be treated as a cautionary label warning users of non-approved equipment or as one providing information but not necessarily a "warning label." Proponents of E15 were concerned that a too-strongly-worded warning label would lead to concerns about the fuel among owners of approved vehicles that could hamper its introduction into the marketplace. Ultimately, EPA and FTC settled on the word "attention" as providing the proper level of information and aligning the design and wording with other similar FTC labels. (See **Figure 3**.)

Figure 3. EPA's New Label for E15 Dispensers



Source: EPA, *EPA Finalizes Regulations to Mitigate the Potential for Misfueling of Vehicles, Engines and Equipment with E15*, EPA-420-F-11-023, Washington, DC, June 2011, <http://www.epa.gov/otaq/regs/fuels/additive/e15/420f11023.pdf>.

⁶⁰ Petroleum Marketers Association of America, *Ethanol Challenges And Opportunities*, Arlington, VA, April 2011, <http://www.pmaa.org/userfiles/file/Legislative/2011/EXPANDING%20GROWTH%20OPTIONS%20FOR%20ETHANOL%20USE.pdf>.

⁶¹ EPA, *EPA Finalizes Regulations to Mitigate the Potential for Misfueling of Vehicles, Engines and Equipment with E15*, EPA-420-F-11-023, Washington, DC, June 2011, <http://www.epa.gov/otaq/regs/fuels/additive/e15/420f11023.pdf>.

Author Information

Kelsi Bracmort
Specialist in Agricultural Conservation and Natural
Resources Policy

Acknowledgments

CRS Section Research Manager Brent D. Yacobucci made important contributions to this report.

Disclaimer

This document was prepared by the Congressional Research Service (CRS). CRS serves as nonpartisan shared staff to congressional committees and Members of Congress. It operates solely at the behest of and under the direction of Congress. Information in a CRS Report should not be relied upon for purposes other than public understanding of information that has been provided by CRS to Members of Congress in connection with CRS's institutional role. CRS Reports, as a work of the United States Government, are not subject to copyright protection in the United States. Any CRS Report may be reproduced and distributed in its entirety without permission from CRS. However, as a CRS Report may include copyrighted images or material from a third party, you may need to obtain the permission of the copyright holder if you wish to copy or otherwise use copyrighted material.